

CLAIMS

1. A method of providing a real-time panoramic video image in a

5 rectangular format; the method comprising the steps of:

6 a) providing a panoramic annular lens system to capture a 360°
7 viewed annular image;

8 b) focusing said 360° viewed annular image on a video camera
9 image plane;

12 d) utilizing said personal computer to unwrap said annular
13 image into a substantially distortion free rectangular image at a rate of at least
14 fps; and

15 e) presenting said rectangular image on a visual display.

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18 2. The method recited in claim 1 wherein in step a) providing said

19 panoramic annular lens system comprises the step of providing a hyperboloidal
20 lens and ellipsoidal mirror.

1 3. The method recited in claim 1 wherein in step b) providing said video
2 camera comprises the step of providing a CCD image plane.

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5 4. The method recited in claim 1 wherein in step b) providing said video
6 camera comprises the step of providing CMOS image plane.

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9 5. The method recited in claim 1 wherein step d) comprises the steps of
10 utilizing radiometric ray tracing to first convert said annular image to a distorted
11 unwrapped image and then to convert said distorted unwrapped image to an
12 undistorted unwrapped image.

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15 6. The method recited in claim 1 wherein step d) comprises the step of
16 employing a vertex-based transformation using graphics processing units of said
17 personal computer.

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20 7. The method recited in claim 1 wherein step d) comprises the steps of
21 capturing said data signal output; converting said video image from said data
22 signal output; manipulating said converted video image; and rendering said
23 image in Cartesian format.

1 8. The method recited in claim 1 wherein step d) comprises the step of
2 using at least one graphics card of said personal computer to unwrap said
3 annular image.

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6 9. An apparatus for providing a real-time panoramic video image in a
7 rectangular format; the apparatus comprising:

8 a panoramic annular lens system configured for capturing 360° viewed
9 annular image;

10 a video camera having an image plane for receiving said annular image
11 and generating a corresponding data signal output;

12 a computer receiving said data signal output;

13 a graphics card and at least one software module in said computer for
14 unwrapping said data signal output from an annular image into a substantially
15 undistorted rectangular image at a rate of at least 30 fps; and

16 a visual display for displaying said rectangular image.

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19 10. The apparatus recited in claim 9 wherein said panoramic annular lens
20 system has a hyperboloidal lens and an ellipsoidal mirror.

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1 11. The apparatus recited in claim 9 wherein said video camera has a
2 CCD imaging plane.

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5 12. The apparatus recited in claim 9 wherein said vide camera has a
6 CMOS imaging plane.

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9 13. The apparatus recited in claim 9 wherein said software module has a
10 program for radiometric ray tracing to first convert said annular image to a
11 distorted unwrapped image and then to convert said distorted unwrapped image
12 to an undistorted unwrapped image.

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15 14. The apparatus recited in claim 9 wherein said software module has a
16 program for vertex-based transformation for unwrapping said annular image.

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19 15. The apparatus recited in claim 9 further comprising means for
20 capturing said data signal output; means for converting said video image from
21 said data signal output; means for manipulating said converted video image; and
22 means for rendering said image in a Cartesian format.

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1 16. A panoramic video system having real-time distortion-free imaging;
2 the system comprising:
3 a panoramic optical system having at least one optical element for
4 viewing a 360° field of view and focusing a corresponding image on an image
5 plane;
6 a video camera having a sensing element at said image plane for
7 converting said image into a corresponding video signal;
8 a computer receiving said video signal and having at least one program
9 for configuring a substantially distortion-free rectangular display of said image at
10 a rate of at least 30 fps; and
11 a monitor for presenting said display.

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14 17. The panoramic video system of claim 16 wherein said optical system
15 optical element comprises an annular element and said corresponding image is
16 an annular image of said 360° field of view.

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19 18. The panoramic video system of claim 16 wherein said video camera
20 comprises a CCD sensing element.

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1 19. The panoramic video system of claim 16 wherein said video camera
2 comprises a CMOS sensing element.

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5 20. The panoramic video system of claim 16 wherein said video camera
6 sensing element has a pixel resolution of at least 1280 x 1024.

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9 21. The panoramic video system of claim 16 wherein said video camera
10 sensing element has a pixel resolution of at least 720 x 480.

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13 22. The panoramic video system of claim 16, said computer comprising at
14 least one graphics card for configuring said rectangular display.

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